SUCTION WET JET MOP

This application claims the benefit, as a continuation-in part, of U.S. Application Serial No. 10/340,691, filed on January 10, 2003, the specification of which is incorporated herein in its entirety by reference.

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] The present invention relates to floor care devices. More particularly, the present invention relates to a combined floor mop and vacuum suction device.

DISCUSSION OF THE ART

[0002] A wide variety of products exist which are capable of cleaning hard surfaces, such as ceramic tile floors, hardwood floors, and the like. Many of these products comprise a directing handle and a sponge for absorbing a fluid cleaning composition. The sponge is rinsed periodically to remove dirt, soil, and other residues. These products are not designed to handle larger particulate material such as crumbs and the like. Such materials are removed either by use of a broom or by use of a vacuum cleaner.

[0003] Non-woven sheets have been used for dry dust-type cleaning, as disclosed, for example, in U.S. Patent Nos. 3,629,047 and 5,144,729. The sheets are designed to attract particulate dirt electrostatically and minimize the amount of residue left on the surface being wiped.

[0004] Recently, cleaning tools have been developed with disposable cleaning pads for removal of dirt from damp surfaces. For example, U.S. Pat. No. 5,094,559 describes a mop that includes a disposable cleaning pad comprising a scrubber layer for removing dirt from a soiled surface, a blotter

layer for absorbing fluid after the cleaning process, and a liquid impervious layer positioned between the scrubber and blotter layers. During the cleaning action with the scrubber layer, the impervious sheet prevents fluid from moving to the absorbent blotter layer. After the cleaning action is completed, the pad is removed from the mop handle and reattached such that the blotter layer contacts the floor. This operation is time consuming for the user and involves the handling of a soiled, wet pad.

[0005] U.S. Pat. No. 5,419,015 describes a mop having removable, washable work pads. Each pad has an upper layer, which is capable of attaching to hooks on a mop head, a central layer of synthetic plastic microporous foam, and a lower layer for contacting a surface during the cleaning operation.

[0006] However, such tools are designed for light floor cleaning and are unsuited to handle large particles of dirt, such as pebbles, crumbs, and the like. There remains a need for a single device that is capable of removing quantities of dry dirt and larger particles, crumbs and the like from a floor surface and also of performing wet cleaning of the surface.

[0007] The present invention provides a new and improved floor cleaning device and method of use, which overcome the above-referenced problems and others and meet the above-stated needs.

SUMMARY OF THE INVENTION

[0008] In accordance with one aspect of the present invention, a cleaning device is provided. The device includes a handle assembly. A cleaning head is pivotally attached to a first end of said handle assembly and configured for receiving a replaceable cleaning pad for collecting dirt from a floor surface to be cleaned. A spray nozzle is mounted on one of said cleaning head and the handle assembly for delivering a cleaning fluid to a floor surface to be cleaned. A liquid delivery system delivers cleaning fluid to the spray nozzle. At least a portion of the liquid delivery system is carried by the handle assembly. A suction nozzle is carried by the cleaning head. A dirt collection assembly is provided for collecting dirt and is in fluid communication with the suction nozzle. The dirt collection assembly is carried by one of the handle assembly and the cleaning head. A source of suction is carried by one of the handle assembly and the cleaning head. The source of suction is fluidly connected

with the dirt collection assembly for creating a flow of working air which draws dirt from the suction nozzle into the dirt collection assembly.

[0009] In accordance with another aspect of the present invention, a cleaning device is provided. The device includes a housing. A suction fan and motor assembly is mounted to the housing. A cleaning head is pivotally mounted to the housing. The cleaning head selectively holds a cleaning pad for collecting dust and debris from a surface to be cleaned. A suction nozzle is carried by the cleaning head. A dirt collecting receptacle is mounted to the housing and is in fluid communication with the suction nozzle and the suction fan and motor assembly. At least one spray nozzle is disposed on at least one of the suction nozzle and the cleaning head. A liquid delivery system is provided for delivering a cleaning fluid to the at least one spray nozzle. At least a portion of the liquid delivery system is mounted on the housing.

[00010] In accordance with another aspect of the present invention, a cleaning device is provided. The cleaning device includes a cleaning head selectively holding a cleaning pad. A handle is provided for directing the cleaning head along a surface to be cleaned. A housing is mounted to at least one of the handle and the cleaning head. A suction fan and motor assembly is mounted to the housing. A dirt collecting receptacle is mounted to the housing. A suction nozzle is fluidly connected with the dirt collecting receptacle. A liquid delivery system is mounted to at least one of the housing and the suction nozzle for delivering a cleaning solution to the surface to be cleaned. The liquid delivery system includes a spray nozzle carried by one of the suction nozzle, the handle, and the cleaning head.

[00011] In accordance with another aspect of the present invention, a cleaning device is provided. The device includes a housing and a suction nozzle communicating with the housing. A suction fan and motor assembly is mounted to the housing. A dirt collecting receptacle is mounted to the housing and is in fluid communication with the suction nozzle and the suction fan and motor assembly. A liquid delivery system is mounted to the housing for delivering a cleaning solution to a surface to be cleaned. A handle is mounted to the housing for grasping to move the cleaning device along the surface to be cleaned. A switch is provided for actuating at least one of the suction fan and motor assembly and the liquid delivery system. A cleaning head is pivotally mounted to the housing, the cleaning head selectively holding a cleaning pad

for collecting dust and debris from a surface to be cleaned.

[00012] In accordance with another aspect of the present invention, a cleaning device is provided. The device has two separate and distinct modes of operation. A first mode of operation comprises suctioning debris from a surface to be cleaned. A second mode of operation comprises application of a cleaning liquid to the surface. A cleaning pad is used to collect dirty cleaning liquid and dust and debris from the surface to be cleaned. The device includes a housing. A suction fan and motor assembly is mounted to the housing. A dirt collecting receptacle is mounted to the housing. A suction nozzle is fluidly connected with the suction fan and motor assembly and the dirt collecting receptacle for performing the first mode of operation. A liquid delivery system is mounted at least in part to the housing for delivering a cleaning liquid to the surface during the second mode of operation. A cleaning head is pivotally mounted to the housing. The cleaning head selectively holds the cleaning pad used during the second mode of operation.

[00013] In accordance with another aspect of the present invention, a cleaning device is provided. The device has a liquid delivery system for cleaning a surface. An elongate handle assembly has first and second ends. A cleaning head is pivotally mounted to the first end of the handle assembly. A cleaning pad is mounted to the cleaning head for collecting dirty cleaning liquid and dust and debris from a surface to be cleaned. A suction nozzle is carried by one of the cleaning head and the elongate handle assembly and is pivotable between a first position, in which the nozzle is located adjacent the surface to be cleaned, and a second position, in which the nozzle is spaced away from the surface to be cleaned. A spray nozzle is provided for spraying liquid from the liquid delivery system in a first cleaning mode. The spray nozzle is mounted to one of the cleaning head, the handle, and the suction nozzle. The suction nozzle is used in a second cleaning mode of the cleaning device.

[00014] In accordance with another aspect of the present invention, a method of cleaning a surface with a device comprising a handle assembly and a cleaning head pivotally attached to the handle assembly is provided. The method includes applying a cleaning solution to the surface from a liquid delivery system at least partially mounted on the handle assembly to a spray nozzle carried by the suction nozzle. The cleaning head is directed over the surface with the handle assembly such that dirty cleaning solution from the

surface is transferred to the cleaning head. Dirt and dirty cleaning solution are selectively suctioned from the surface through a suction nozzle attached to one of the cleaning head and the handle assembly.

[00015] In accordance with another aspect of the present invention, a cleaning device is provided. The device includes a suction nozzle and a dirt collection assembly for collecting dirt and in fluid communication with the suction nozzle. The dirt collection assembly includes a dirt cup configured for collecting a first portion of the dirt. A baffle is received within the dirt cup. The baffle provides a tortuous path for air and entrained dirt. The baffle defines a dirt receiving region configured for collecting a second portion of the dirt. A filter is received within the dirt cup. A source of suction is fluidly connected with the dirt collection assembly for creating a flow of working air which draws dirt from the suction nozzle into the dirt collection assembly such that a first portion of the dirt is collected in the dirt cup, and a second portion of the dirt is collected in the baffle receiving region, and a remaining portion of the dirt is removed by the filter.

[00016] The advantages of the present invention will be readily apparent to those skilled in the art, upon a reading of the following disclosure and a review of the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[00017] The invention is described in conjunction with accompanying drawings. The drawings are for purposes of illustrating exemplary embodiments of the invention and are not to be construed as limiting the invention to such embodiments. It is understood that the invention may take form in various components and arrangement of components and in various steps and arrangement of steps beyond those provided in the drawings and associated description.

[00018] FIGURE 1 is a front perspective view of a first embodiment of a floor cleaning device according to the present invention;

[00019] FIGURE 2 is an exploded perspective view of the floor cleaning device of FIGURE 1;

[00020] FIGURE 3 is an enlarged perspective view of the lower end of the cleaning device of FIGURE 1, showing the suction nozzle in a raised position,

with the spray nozzle shown displaced from the suction nozzle, for clarity;

[00021] FIGURE 4 is a side sectional view of the cleaning device of FIGURE 1;

[00022] FIGURE 5 is an enlarged exploded perspective view of a lower portion of the floor cleaning device of FIGURE 1;

[00023] FIGURE 6 is a bottom plan view of an alternative embodiment of a floor cleaning pad attached to a lower surface of a cleaning head of a floor cleaning device, with one corner of the pad peeled back to reveal its multi-layer construction;

[00024] FIGURE 7 is an enlarged exploded perspective view of part of a handle assembly of the floor cleaning device of FIGURE 1;

[00025] FIGURE 8 is an exploded perspective view of a fluid delivery system for the cleaning device of FIGURE 1;

[00026] FIGURE 9 is exploded perspective view of a cleaning fluid reservoir of the floor cleaning device of FIGURE 1;

[00027] FIGURE 10 is an enlarged side sectional view of an upper portion of a handle assembly of the floor cleaning device of FIGURE 1;

[00028] FIGURE 11 is an exploded perspective view of the upper portion of a handle assembly of FIGURE 10;

[00029] FIGURE 12 is an enlarged exploded rear perspective view of a dirt cup assembly of the floor cleaning device of FIGURE 1

[00030] FIGURE 13 is a reduced front exploded perspective view of the dirt cup assembly of FIGURE 12;

[00031] FIGURE 14 is an enlarged exploded perspective view of a filter and frame of the dirt cup assembly of FIGURE 13; and

[00032] FIGURE 15 is an enlarged exploded perspective view of a suction fan and motor assembly of the floor cleaning device of FIGURE 1.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[00033] Referring now to the FIGURES, wherein the showings are for purposes of illustrating several preferred embodiments of the invention only and not for purposes of limiting the same, **FIGURE 1** illustrates a floor cleaning device **10** suited to the cleaning of vinyl, ceramic, and finished wood floors, and other hard surfaces. The floor cleaning device **10** incorporates both mopping and suction functions, allowing an operator to change rapidly from dirt suctioning to mopping.

[00034] The cleaning device **10** includes a cleaning head **12** for contacting a floor surface **13** to be cleaned, and an elongate handle assembly **14**, which is pivotally attached to the cleaning head by a universal joint **16**, best shown in **FIGURE 2**. During floor cleaning, the handle assembly **14** is positioned at an acute angle to the direction of travel of the cleaning head **12**, for directing the cleaning head across the floor surface.

[00035] A suction nozzle **18** extends forward of a leading edge **20** of the cleaning head **12** and is movable between a floor suctioning position, illustrated in **FIGURE 2**, and a raised position, illustrated in **FIGURE 3**. One or more spray nozzles **22** are mounted to the cleaning device for delivery of a spray of cleaning fluid onto the floor surface adjacent the cleaning head. In the illustrated embodiment, the spray nozzle **22** is attached to an upper end of the suction nozzle **18**, and thus is movable with the suction nozzle. In an alternative embodiment, the spray nozzle is attached to an upper surface of the cleaning head **12**, to the universal joint **16**, or elsewhere on the cleaning device for delivering a spray of a cleaning fluid to the floor surface. In yet another embodiment, the spray nozzle clips onto the cleaning head, allowing it to be removed from the device when not in use. The spray nozzle **22** can produce a fine spray which contacts the floor forward of the cleaning head **12**. The spray created by the nozzle(s) **22** may be a fluidic oscillating spray, a fan angled spray, or a uniform distribution spray, as desired. In one embodiment, an oscillating spray is employed which delivers cleaning fluid across a fan-shaped area over about 52° forward of the cleaning head. One suitable spray nozzle for generating such an oscillating fan pattern is a fluidic oscillator obtainable from Bowles Fluidics Corp., 6625-T Dobbin Rd, Columbia, MD 21045. The cleaning head **12** picks up at least a portion of the sprayed cleaning fluid, together with dirt loosened from the floor surface. In the illustrated embodiment, the spray nozzle **22** is carried by a spray tip cover **24**,

which is removably attached to the upper end of the suction nozzle **18**, although other attachment means are also contemplated.

[00036] The cleaning fluid can be a liquid, such as water or a suitable conventional cleaning solution. Suitable cleaning liquids include those marketed by Procter and Gamble and by Clorox for use with their Swiffer™ Wet Jet and ReadyMop™ floor cleaning devices. For example, the cleaning fluid can include a detergent in water for improving the removal of dirt from the floor. The cleaning liquid may include other additives, such as antimicrobial agents, bleaches, and the like. For cleaning wood floors, the cleaning fluid can be formulated to minimize damage to the floor and may include a wax or other wood floor coating ingredients.

[00037] With reference to **FIGURE 1**, the handle assembly **14** includes an upper handle portion **26** and a housing **28**, which is mounted to a lower end of the upper handle portion. As shown in **FIGURES 4** and **7**, the housing **28** accommodates a fan and motor assembly **30**, a dirt collection assembly **32**, a power source **34**, such as one or more replaceable/rechargeable batteries, a cleaning fluid supply reservoir **36**, and a cleaning fluid delivery pump **38**, each of which will be described in greater detail below.

[00038] With reference once more to **FIGURE 2**, the universal joint **16** permits rotation of the cleaning head **12** relative to the handle assembly **14** about two rotational axes, as indicated by arrows R_1 and R_2. The rotational axes are angularly spaced, preferably by about 90°. As shown in **FIGURE 5**, the universal joint **16** includes a first rotational joint or clevis **39** comprising first and second spaced and generally parallel arms **40, 42**, which extend downward from opposite sides of a central portion **44**. The arms **40, 42** receive disk-shaped pivot pins **50** which are also received in respective aligned apertures **51, 53** positioned in spaced flanges **52, 54** extending upward from the cleaning head **12**. In other words, the clevis **39** is rotatably mounted on the cleaning head **12**. The handle assembly **14** is thus able to pivot forward or rearward, relative to the cleaning head **12**, as shown by arrow R_1 in **FIGURE 2**.

[00039] The universal joint **16** includes a second clevis or rotational joint **55**, oriented perpendicular to the first clevis **39**. The second clevis **55** includes first and second spaced and generally parallel arms **56, 58**, similar to arms **40, 42**, which extend upward from an opposite face of the central portion **44** to the

arms **40, 42**. The arms **56, 58** are pivotally connected to flanges **60** (see **FIGURE 2**) at a lower end **64** of the housing **28** by pivot pins **66**. This allows the handle assembly **14** to pivot relative to the universal joint **16** as shown by arrow R_2 (**FIGURE 2**). The second rotational joint **55** thus has a rotational axis perpendicular to the axis of the first rotational joint **39**. It will be appreciated that other conventional methods of attachment of the handle assembly **14** to the cleaning head **12** are also contemplated. The central portion **44** includes a large aperture **68** for accommodating a hose, as will be discussed below.

[00040] For floor mopping operations, the cleaning device **10** can be maneuvered, for example, forwards and backwards or side to side by moving the handle assembly **14** as required. As a result, the movement of the handle will be translated, via the universal joint **16**, to the cleaning head **12**.

[00041] With reference once more to **FIGURE 5**, the cleaning device **10** accepts a cleaning fabric pad **70**, which is removably attached to the cleaning head **12** such that it covers a substantially flat lower surface **72** of the cleaning head. The lower surface **72** can be defined by a rectangular plastic or foam plate **73**. The cleaning pad **70** may be formed from multiple layers or be a single sheet of material. In one embodiment, the pad **70** has a multilayer construction including an upper layer **70A**, formed form a water impermeable material, such as plastic. An intermediate layer **70B** is formed from a highly absorbent material, such as a synthetic plastic microporous foam. A lower layer **70C** includes extension portions **74**, which extend beyond the perimeter of the upper layers such that the layer **70C** can be wrapped around the cleaning head **12** and releasably attached to an upper surface **75**, as described below.

[00042] The lower layer **70C** is preferably formed from a fabric which is sufficiently durable such that the layer will retain its integrity during the cleaning process. It is permeable to water and other liquids, which pass through the lower layer into the absorbent layer **70B**, where they are trapped. The pad is preferably disposable, although reusable pads, which can be cleaned by washing, are also contemplated. It is also contemplated that different types of pad may be used depending on the type of cleaning to be performed. For example, if the user plans to do only dry cleaning at a particular time, a pad **70** comprising an electrostatic layer suited to picking up dry dirt may be employed. Such pads are particularly suitable for removal

and entrapment of dust, lint, hair, grass, and the like. Pads particularly suited to polishing and/or buffing wood floors may be selected for wood floor cleaning operations.

[00043] With continued reference to **FIGURE 5,** the upper surface **75** the cleaning head **12** may be defined by a support plate **76**, formed from metal or plastic, which is attached at a lower surface thereof to the plate **73.** Gripping members or clips **78** are provided on the upper surface **75**, or elsewhere on the cleaning head, for releasable gripping the pad **70.** Specifically, the gripping members each include a slit or slits **79** in a deformable material which allow the extension portions **74** of the pad to be pushed into a hole created by temporary deformation of the area around the slit when the gripping member is pressed. The gripping members may be removably attached to the support plate **76** (for example, using corresponding threaded regions, as shown) to allow the gripping members **78** to be replaced by gripping members of the same or of a different type.

[00044] **FIGURE 6** shows an alternative embodiment of a pad **70'**, where similar elements are identified with a primed (') suffix and new elements are identified by new numerals. The pad **70'** has a multilayer construction including an upper layer **70'A**, which is capable of attaching to a strip of conventional hook material **73A** secured to a plate **73'**. Also provided are an intermediate layer **70'B** of an absorbent material, and a lower layer **70'C** for contacting a surface meant to be cleaned during the cleaning operation. The pad upper layer **70'A**, which includes a loop material, and the hook material **73A** cooperate to form a hook and loop fastening system of the well known Velcro™ type. The hook material **73A** can be adhesively attached or molded onto the surface **72'**, although other attachment methods are contemplated. Thus, the bottom surface **72'** of the cleaning head **12** engages at least a portion of the cleaning pad **70'** during use.

[00045] With reference once more to **FIGURE 2**, the housing **28** includes a front socket **80**, which receives the dirt cup assembly **32**. The lower end **64** of the housing **28** is pivotally connected with the universal joint, below the socket, as described above. The housing **28** also defines a rear socket **81**, best shown in **FIGURE 7**, with an upper opening **82** for receiving the cleaning fluid reservoir **36**, which may be in the form of a replaceable bottle. The upper handle portion **26** (**FIG. 2**) includes a cylindrical sleeve **84**, the lower end of which is received through an opening **86** in the housing. The end of the

sleeve **84** is bolted or otherwise fixedly attached to the housing **28**. The housing **28** can be formed from two, three, or more housing portions **87, 88** and **89,** which are screwed, adhesively attached, snap fitted or otherwise connected together to form the housing.

[00046] With continued reference to **FIGURE 7**, a liquid delivery system **90**, which includes the pump **38**, delivers the cleaning liquid from the reservoir **36** to the spray nozzle **22**. As the reservoir **36** is inserted into the housing, the reservoir is automatically connected with the liquid delivery system **90**. Specifically, the reservoir **36** includes a first closure or cap **92** (**FIG. 9**), which is brought into engagement with an opening assembly **94** of the pump, best shown in **FIGURE 8**. The opening assembly **94** may include a spring biased valve opening member **95**, which opens a valve **96** mounted within the cap **92** of the reservoir. The valve **96** may also be biased by a spring **97** into a closed position, unless acted on by the opening assembly **94**.allowing fluid to flow from a lower opening or outlet **98** in a reservoir bottle **99** to the pump **38**.

[00047] With reference now to **FIGURE 9**, a vent valve **100** allows air to enter the bottle to replace the volume of fluid dispensed. That is, as cleaning fluid is pumped from the reservoir **36**, ambient air is admitted through the vent valve **100** to replace the fluid so that the reservoir does not collapse or generate a vacuum within the container **36**. The reservoir vent valve **100** may be associated with a second cap or closure **102**, which closes an upper opening or inlet **104** in the bottle **99**. The second opening **104** is positioned above the fluid level, e.g., at an opposite end of the bottle from the lower opening **98**. The bottle **99** may be about a 25 cm tall by about 6 cm diameter bottle blow molded from a high density polyethylene or other suitable plastic.

[00048] Alternatively, the vent valve may be located below the fluid level. In one embodiment, the vent valve is associated with the cap **92** and is positioned adjacent to the valve **96**.

[00049] Another suitable connection mechanism for the reservoir is described in U.S. Patent No. 6,321,941, which is incorporated herein in its entirety by reference. In such a system, a closure or cap of the bottle is brought into engagement with a bottle piercing assembly, which is movably mounted in the socket **81**. The bottle piercing assembly includes two piercing needles which puncture a portion of the cap, such as an elastomeric gasket.

One of the needles is connected with a vent valve, which allows air to enter the reservoir**36** as the cleaning liquid is dispensed. The other needle is fluidly connected with the pump **38**. The gasket may be injection molded of silicone rubber.

[00050] With reference once more to **FIGURE 8**, the pump **38** can be an impeller pump, a gear pump, peristaltic pump, or any other known liquid pump. In the illustrated embodiment, the pump is a vaned impeller pump. The pump includes an impeller **110**, with a plurality of radially spaced vanes **112**, five in the illustrated embodiment. The vanes direct the fluid radially outward, towards the walls of a pump housing **114.** A fluid supply pathway **116** connects the pump housing with the spay nozzle **22**. A drive motor **118** for the pump **38** is powered by the power source **34** (**FIG. 7**), such as batteries. For example, a low-voltage DC motor **118** is readily powered by the batteries **34**. The cleaning device **10** may be configured to employ a wall mounted charger (not shown) for recharging the batteries without the need for removing them from the housing. Alternatively, a socket (not shown) in the housing is adapted to receive a drop in battery pack. One such battery pack is sold by Black and Decker, Inc. of Towson, Maryland, under the mark Versapack™. Although batteries **34** represent one means for powering and operating the pump **38**, other alternatives may be used. For example, an electric power cord (not shown) can be selectively connected to a source of AC power for supplying electrical power to the pump **38**, fan motor **30**, and any other electrically operated components of the device, or, the pump may be manually operated.

[00051] The fluid flows through an opening in the pump housing **114** and travels via the fluid supply path **116** to the spray nozzle **22**. The fluid supply path includes a first fluid supply conduit **120,** such as a flexible tube, which connects the pump housing with the inlet of a solution filter **122**. The solution filter filters dirt and other small particles from the cleaning liquid which may clog the spray nozzle. If the cleaning fluid is free of particles, the filter may not be needed.

[00052] The outlet of the solution filter **122** is connected by a second conduit **124** to the inlet of check valve **126**. The check valve **126** may be a solenoid valve, spring loaded ball valve, or other type of check valve commonly known in the art. The check valve **126** limits a dribbling of fluid from the spray nozzles **22** particularly when the suction nozzle **18** is in operation. The

check valve **126** may also generate a cracking pressure so that fluid entering into the spray nozzle(s) **22** has sufficient energy to drive the fluid through the spray nozzle(s) **22** and break the fluid up into fine droplets.

[00053] In an alternative embodiment embodiment, the check valve **126** also serves as a shut off valve which remains closed until it is desired to dispense fluid from the spray nozzle. Or, a separate shutoff valve may be provided elsewhere in the fluid pathway **116**. In such an embodiment, the pump can be left running continuously throughout a floor cleaning operation, running continuously in both mopping and suction modes. For this embodiment, the valve **126** would be used to close off the flow during the suction mode. Alternatively or additionally, the pump **38** can be switched off during the suction mode.

[00054] Another suitable pump for use as the solution pump is a gear pump as is described in U.S. Patent No. 6,328,543, which is incorporated herein in its entirety by reference. Because of the continuous static head from the reservoir **36**, a check valve analogous to the check valve **126** can have a cracking pressure greater than the static head, so that no leakage occurs through an inactive pump. The cracking pressure could be higher than the static head to the extent that fluid passing through the check valve **126** when the pump operates has sufficient pressure to cause the spray nozzle **22** to produce a fine spray.

[00055] Vaned impeller pumps have advantages in that the dimensions are less critical and tolerances for the vanes are larger than is the case with gears in a gear pump. If a gear pump is used, the reservoir **36** can be located directly above the gear pump so that a static head is always present to prime the pump, and no suction is required. This helps to minimize precision and power, and therefore size and cost of the pump. With a vaned impeller pump, the reservoir need not be located above the pump. Although it may be convenient to do so.

[00056] A third conduit **128** is connected with an outlet of the check valve **126** and passes out of the housing **28**. The conduit **128** connects at its distal end with the nozzle **22**.

[00057] As can be seen in **FIGURES 2** and **7**, the conduit **128** may be routed through an opening **130** in the lower end of the housing **28** so that the

supply conduit does not need to pass through the u-joint and potentially become entangled in the suction hose. A slot **132** (**FIG. 5**), formed in an external surface of the central portion **44** of the u-joint, receives the conduit **128** therethrough. Alternatively, the hose **128** may be clipped to an exterior surface of the u-joint by a suitable clip.

[00058] The fluid delivery system **90** thus described includes conduits **120, 124, 128**, pump **38**, check valve **126,** filter **122**, and optionally, a separate shut off valve. It will be readily appreciated, however, that alternative fluid delivery systems, such as those employing gravity feed, pressure on the bottle by squeezing with the user's hand, or other means of supplying the fluid to the nozzle **22**, are also contemplated.

[00059] With reference to **FIGURE 10**, the upper handle portion **26** includes a hand grip **140**, which may be assembled from left and right hand grip portions **142, 144**, as illustrated in **FIGURE 11**. The left and right hand grip portions are screwed, bolted or otherwise attached to each other to enclose an upper end of the sleeve **84**. A manually operable actuation system **150**, best is associated with the hand grip and operates the fan and motor assembly **30** and the pump **38** and/or valve **126**. The actuation system **150** includes a thumb or finger-operated thumb switch **152** and a trigger **154**, which can both be mounted to the hand grip **140**. In the illustrated embodiment, the hand grip is formed from left and right hand grip portions **142, 144**.

[00060] The trigger **154** is pivotally mounted to the handle grip and has an extension portion **156** which extends into the hand grip. The end of the extension portion is received within a slot **158** in an upper end of an actuation rod or linking rod **160**. The linking rod **160** is carried within the hollow sleeve **84**. When the trigger is depressed, the linking rod is pushed in a generally downward direction, illustrated by arrow **A**, away from the hand grip **140**. The actuation rod **160** carries an actuating member **162**, such as a protrusion or ring, which actuates a first microswitch **164** (**FIG. 11**). The actuation of the first microswitch **164** energizes the fluid supply pump **38** (and/or actuates the shut off valve **126** to move to the open position), whereby the supply of liquid from the reservoir **36** to the spray nozzle **22** is initiated. In this mode, the pump **38** withdraws cleaning solution from the reservoir **36** and directs it to the spray nozzle **22**, via the fluid supply pathway **116**. A user maneuvers the cleaning head **12** over the floor, using the handle assembly **14**. The sprayed

cleaning fluid and dirt from the floor are collected on the replaceable pad **70** as the cleaning head passes across the floor.

[00061] When pressure on the trigger is released, a torsion spring **165** biases the trigger to the off position, and the fluid delivery is interrupted.

[00062] The switch **152** is operable to convert the device **10** from the mopping mode to the vacuum suction mode. Specifically, when the thumb switch **152** is depressed, the actuation rod or linking rod **160** is pushed in a generally upward direction, illustrated by arrow **B** towards the hand grip **140**. The actuating member **162** actuates a second microswitch **166** (**FIG. 11**) only when the thumb switch **152** is depressed. In particular, the thumb switch **152** engages a trigger arm **168** which is pivotally mounted to the hand grip. Pressure on the thumb switch rotates the trigger arm, causing the trigger extension **156** to pull the actuation rod **160** in the direction of arrow **B**.

[00063] The second microswitch **166** can be mounted, either in the sleeve **84** or in the housing **28**, in spaced relation to the first microswitch **164**. Actuation of the switch **166** causes the fan motor assembly **30** to operate, creating a suction force on the suction nozzle **18**. Additionally, it will be appreciated that when the actuation rod **160** is retracted, by pulling upward, the protrusion **162** is released from engagement with the first microswitch **164**, switching off the pump **38** (and/or closing the shut off valve **134**) and thereby closing off and/or switching off fluid flow to the spray nozzle **22**.

[00064] The floor cleaning device **10** is thus operable in a suction mode. The user maneuvers the cleaning head **12** over the floor surface using the handle assembly **14**. The suction fan motor assembly **30** creates a flow of working air at a suction inlet **170** (**FIG. 6**) of the suction nozzle **18**. Dirt and dust from the floor enter the suction nozzle inlet **170** and are carried along a working air flowpath **172** (**FIG. 4**), defined in part by the suction nozzle **18**, and into the dirt collection assembly **32**, along with the working air. If both suction and mopping operations are to be carried out, the suction operation can be performed first and then the device **10** can be converted to the spray/mopping mode by changing the switch position.

[00065] The trigger arm **168** includes a flat spring **173**, which biases the thumb switch **152** to the off position when the pressure on the switch is removed. Optionally, a thumb lock button **174** is actuated (e.g., slid

forwardly) to lock the switch **152** in a selected position, such as the depressed position. This allows the user to lock the switch in the suction mode. The switch **152** can be released by sliding the lock button rearwardly.

[00066] Other embodiments are also contemplated, such as a single switch which operates to either actuate fluid delivery or to actuate suction. For example, a slide switch may have first and second positions, S_1, S_2, for actuating the microswitches **164** and **166**, respectively, and optionally an intermediate, OFF position S_3, in which neither of the microswitches is actuated.

[00067] It will be appreciated that the positions of the two microswitches **164, 166** shown in **FIGURE 11** may be reversed, such that the fan motor assembly **30** is operated by pulling on the trigger **154** and the liquid spray is operated by pushing on the switch **152**. Additionally, while the switch **152** and trigger **154** are most conveniently positioned on or adjacent the hand grip **140**, it is also contemplated that one or other of the switch **152** and trigger **154** may be positioned elsewhere on the device **10**. For example, a foot operated rocker switch may be provided on the cleaning head, or the switch may be located on the housing.

[00068] As noted above, the suction nozzle **18** is movable between a first position, in which the inlet is adjacent the floor surface, and a second position, in which the nozzle inlet is spaced from the floor surface. More particularly, and with reference again to **FIGURE 5**, the suction nozzle **18** is pivotably mounted on the support plate **76** by a pair of spaced apart arms **180, 182,** which extend from a rearward end **184** of the suction nozzle. The arms **180, 182** each have a hole **186, 188,** respectively, through which pivot pins **190** extend to rotatably secure the suction nozzle to the corresponding flanges **52, 54** extending from the upper surface **75** of the support plate **76**.

[00069] Each of the suction nozzle arms **180, 182** has a forward and a rearward concave surface **192, 194** which engage or ride upon a respective detent **196** in the form of a flat spring. Ends of the flat spring **196** snap fit into corresponding slots **198** defined in the support plate upper surface **75**, adjacent the respective support plate flange **52, 54**. The suction nozzle **18** is manually pivoted or rotated from an operating (suction) position, in which the nozzle is adjacent to the floor surface, to a non-operating (retracted/raised) position. In the suction position, illustrated in **FIGURE 2**, the forward

surface **192** engages the flat spring **196**. In the retracted position, the rearward surface **194** engages the flat spring. The suction nozzle **18** is able to move from one position to the other, under slight manual pressure, since the surfaces **192, 194** ride along the detent **196** until the suction nozzle is locked into one of the two positions.

[00070] In the suction position, the suction nozzle **18** is aligned adjacent to and generally parallel with the floor surface to be cleaned, with the suction inlet **170** pointing towards the floor. Air entrained dirt is drawn from the suction nozzle **18** to the dirt collection assembly **32,** via a flexible hose **200,** which passes through the opening **68** (**FIG. 2**). The flexible hose **200** is connected to the lower end of the housing **28** by a collar **202**. In the retracted position, the inlet is spaced away from the floor, allowing easy removal of the cleaning pad **70**.

[00071] Alternatively, the suction nozzle **18** could be spring biased to the retracted (raised) position. In such an embodiment, a latch (not shown) or other suitable restraining member would restrain the suction nozzle **18** against upward movement when the nozzle is in the suction position. The latch would be movable between an engaged position, in which the latch engages the suction nozzle **18** and a disengaged position, in which the suction nozzle is free to move upwardly, under the bias of the torsion spring. The latch can be normally restrained in the engaged position by a foot operated release member (not shown), which includes a foot operated switch, positioned on the cleaning head **12** or in other convenient location. To reengage the suction nozzle **18** with the latch, the user pushes the suction nozzle downward with either the foot or hand and reengages the latch. Such a latch mechanism is shown for example in application Serial No. 10/340,691, which is incorporated herein by reference.

[00072] In another alternate embodiment, a lower end of the actuation rod **160** is operatively connected with the suction nozzle **18,** such that the suction nozzle **18** is moved from the floor suctioning position (**FIGURE 2**) to the retracted position (**FIGURE 3**) when the switch **152** is depressed.

[00073] With reference now to **FIGURE 13**, the dirt collection assembly **32** includes a dirt collection receptacle **208**, such as a removable, generally transparent dirt cup, fabricated from a thermoplastic material, or other suitable material. The dirt cup defines a dirt collection chamber **210**. As best

shown in **FIGURE 4**, when the dirt cup **208** is positioned within the socket **80** in the housing **28**, the suction nozzle **18** is fluidly connected with an inlet **212** of the dirt cup **208** by the flexible suction hose **200**. The air from the suction hose **200** passes through the collar **202** mounted in the aperture **68** in the universal joint **16** and enters the housing **28** through a suitably positioned lower opening **214** located between the two flanges **60, 62 (FIG 2)**.

[00074] A flap valve or dust cover **215** (**FIGURE 4**) positioned at the dirt cup inlet **212** is normally in a closed position. When the fan motor operates, the suction force opens the flap valve **215**, allowing dirt and air to be drawn into the dirt cup **208**. The flap valve **215** may be formed from rubber or other suitable flexible material. When the fan motor is switched off, the flap valve falls back to its closed position, sealing off the suction nozzle **18** from the dirt cup **208** and preventing collected dirt from falling out of the device through the suction nozzle.

[00075] As shown in **FIGURE 13**, an open end **216** of the dirt cup **208** selectively accommodates a removable filter assembly **218**, which directs the airflow and filters dirt and debris from the working air before it leaves the dirt cup. As best shown in **FIGURE 14**, the filter assembly **218** can include a filter member **220** to retain smaller particles within the dirt cup **208**. The filter member **220** includes a filter support or cage **222**, and a flexible filter **224** supported thereon. The filter member is removable from a baffle **226,** mounted in the dirt cup **208**, for cleaning. The dirt cup **208** is removed from the socket **80** in the housing and emptied of collected dirt at intervals. This entails removing the filter assembly **218** from the dirt cup and tipping out collected dirt. The filter assembly **218** may also be cleaned at this time, or less frequently, for example, by rinsing the filter member **220** in water or a detergent solution.

[00076] The filter assembly also includes a baffle **226**, which is positioned within the dirt cup such that a flange **228** at an open end thereof seals around the opening in the dirt cup. The flange may be fitted with an overmolded seal **229** formed from rubber or other compressible material, to aid in creation of a seal between the flange and the dirt cup. The baffle **226** defines an upper opening **230** shaped to receive the filter member therethrough, whereby the filter member is seated in the baffle. A flange **232** at an upper end of the filter cage **222** forms a seal between the filter member and the baffle **226**.

[00077] As best shown in **FIGURE 12**, the baffle **226** includes an annular, generally vertical wall **234** which is closed at a lower end with a base **235**. The annular wall defines a side opening **236** which serves as an air inlet through which air enters a chamber **237** within the baffle. Air enters the dirt cup **208** via the movable flap valve **215** at the end of the tube **200** and follows the flow path **172** illustrated in **FIGURE 4**.

[00078] The air is directed along a convoluted pathway by a curved deflector wall **238**, which extends below the baffle opening at least in the region of the baffle opening to partially surround the flap valve **215**. The deflector wall has an opening **240**, radially spaced about 180° from the baffle opening, to provide room for the flap valve to open. The air flows between the deflector wall **238** and the inside of the dirt cup to the baffle opening **236**. A shelf **242**, which extends laterally adjacent the lower end of the opening and a pair of vanes **244**, extending from the inside of the dirt cup **208** assist in directing the air around the baffle vertical wall **234** and into the baffle opening **236**. The convoluted air path causes much of the dirt and substantially all of the moisture in the air stream to drop out of the air stream into the dirt cup **208**. This allows use of a fan and motor which are not specifically designed for use with air laden with water droplets. A further portion of the dirt, mostly dry dirt of a lighter weight, enters the opening **236** and collects in a well **246** defined between the base **235** of the baffle chamber **237** and the opening **236**. Any remaining fine pieces of dirt carried through the baffle opening **236** in the air stream are trapped on the filter **224**.

[00079] The baffle well **246** thus provides an additional dirt collecting region, which increases the dirt collection capacity of the dirt collection assembly. Once the level of dirt in the dirt cup **208** reaches about the level of the flap valve **215**, it is desirable to empty the dirt cup and baffle chamber of collected dirt.

[00080] As shown in **FIGURE 2**, during operation of the suction system, the dirt cup **208** is secured in place in the socket **80** by a latch mechanism **250** or other suitable conventional fastening mechanism. With reference now to **FIGURE 7**, to remove the dirt cup **208**, depression of a release button **251** of the latch mechanism **250** can release a spring biased tab **252** from a slot **254** (**FIG. 12**) formed in the outlet end of the dirt cup **208**. It should be apparent from **FIGURES 12** and **13** that the baffle **226** and dirt cup **208** can be keyed, as at **256**, **257** so that the baffle only fits in the dirt cup in one orientation.

Similarly, the filter member **220** can be keyed, as at **258, 259**, for one way receipt into the baffle **226** so that the portion of the filter **224** exposed through the opening **236** is free of seams to maximize airflow (**FIG. 13**).

[00081] With reference now to **FIGURE 15**, the fan and motor assembly **30** includes a motor **260** capable of operating on a dc voltage of about 7.2-9.6 volts DC, provided by the power source **34** (**FIGURE 7**) and a fan assembly **262**. The fan assembly includes a diffuser cover **264**, fan cover **266,** fan bottom **268**, and radial diffuser **270** which are stacked together to form the fan assembly. The fan cover **266** and fan bottom **268** serve as an impeller **272**, which is rotated by the motor **260** to create a suction force on the dirt cup **190**, drawing air and dirt from the floor suction nozzle **18** into the dirt cup.

[00082] The air is drawn through the diffuser cover **264** via a central opening **276** therein and directed radially outwardly by vanes **278** on the fan cover **266**. The radial diffuser **270** has a plurality of vanes **282** which are angled to direct the air flow outward. The air is directed through a plurality of arcuately spaced apertures or slots **284** in an upper end of the diffuser cover **264**. This system provides an efficient means of directing the air stream away from the fan in a direction generally perpendicular to the axis of rotation of the fan. The fan is thus capable of operating on a relatively low-powered motor. It also reduces the possibility of moisture in the air coming into contact with the motor and causing damage.

[00083] With reference again to **FIGURE 4**, when the fan motor assembly **30** is operational, the working air follows a short and efficient flow path. Dirt-laden air is drawn in through the suction inlet **170** of the suction nozzle and is carried upward along the short flexible hose **200** and exits out the dirt cup inlet **212**, which is elevated, relative to the base of the dirt cup **208**. Heavier dirt particles fall to the base of the dirt cup **208** under gravity. Any fluid in the airstream is separated out by the tortuous flow path around baffle **226**, along with additional dirt or dust. Lighter particles may be drawn upward in through the baffle opening **236**, where they are trapped on the filter **220** or in the baffle well **246** beneath the filter. Working air is drawn through the filter **220** by fan assembly **262,** flows away from the motor **260,** and is directed out of the housing by the fan and motor assembly **30** through suitably positioned louvers **286** therein (**FIG. 7**).

[00084] In place of the dirt cup **208** and filter assembly **218**, another

suitable conventional dirt collection assembly may be employed, such as a replaceable filter bag made from paper, cloth, or other porous material, a cyclonic flow dust separation system, or the like.

[00085] With reference to **FIGURE 2**, a brush **290** or other suitable cleaning tool can be removably mounted to the handle assembly to aid in dislodging dirt which is too firmly adhered to the surface to be readily removed by the cleaning pad or suction nozzle alone. A lower hand grip **292** may be mounted to the handle sleeve **84** for ease of lifting the cleaning device.

[00086] The invention has been described with reference to the preferred embodiments. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.